

Chapter 2

Introduction to Adaptive Filters

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Abstract This chapter introduces the general concepts of adaptive filtering and its families of algorithms, and settles the basic notation used in the remaining of the book. Section 2.1 presents the fundamentals concepts, highlighting several configurations, such as system identification, interference cancelation, channel equalization, and signal prediction, in which adaptive filters have been successfully applied. The main objective functions associated to optimal filtering are then introduced in Section 2.2, followed, in Section 2.3, by the corresponding classical algorithms, with emphasis given to the least-mean square, data-reusing, and recursive least-squares (RLS) families of algorithms. It is observed that RLS algorithms based on the so-called QR decomposition combines excellent convergence speed with good numerical properties in finite-precision implementations. Finally, computer simulations are presented in Section 2.4, illustrating some convergence properties of the most important adaptation algorithms. For simplicity, all theoretical developments are performed using real variables, whereas the algorithm pseudo-codes are presented in their complex versions, for generality purposes.

2.1 Basic Concepts

In the last decades, the field of digital signal processing, and particularly adaptive signal processing, has developed enormously due to the increasingly availability of technology for the implementation of the emerging algorithms. These algorithms have been applied to an extensive number of problems including noise and

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